FY21 Performance Progress Report

Due date:

Cover Page

Principle Investigator (PI):	
Institution:	
E-mail:	
Phone:	
Fiscal Year:	
USDA-ARS Agreement ID:	
USDA-ARS Agreement Title:	
FY20 USDA-ARS Award Amount:	
Recipient Organization:	
DUNS Number:	
EIN:	
Recipient Identifying Number or Account Number, if any:	
Project/Grant Period:	
Reporting Period End Date:	

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
	FY21 Total ARS Award Amount	

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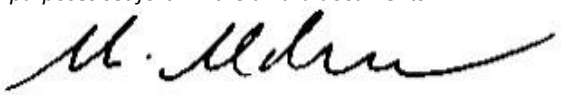
I certify to the best of my knowledge and belief that this report is correct and complete for performance of activities for the purposes set forth in the award documents.



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Project 1:

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1. What are the major goals and objectives of the research project?

The overarching goal of this project is to continue breeding procedure and produce new genetic variations that harbor both yield and FHB resistance traits, and ultimately releasing high yielding varieties to growers. The detailed objectives are: producing new breeding crosses every year, generation advancement of breeding populations, and line testing locally and regionally.

2. What was accomplished under these goals or objectives? *(For each major goal/objective, address these three items below.)*

a) What were the major activities?

Objective 1. Breeding crosses. We have performed greater than 200 breeding crosses in the last two greenhouse cycles spanning fall 2021 and spring 2022. We have identified highest yielding lines from stage-1 nursery of 2020-21 by phenotypic evaluation and genomic predictions in July-August 2021. Best lines were intercrossed in fall 2021 crossing nursery. F1 plants were grown in greenhouse during summer 2022. Seeds of F2 generation will be collected in August 2022. Large plot (or long row) F2 generations will be planted in fall 2022. That is one year from identification of high yielding lines to sowing of F2 generation in the field.

Objective 2. Generation advancement. We have planted 118 family of F2s in 3.7 ft wide x 6 ft long plots and 61 F2 families in 15 ft long rows. The seed amount was the reason for this variation in planting. Selection among families were conducted twice during the season for disease pressure and final selection for plant population and head size was conducted during the harvest. 20 heads from each selected family were picked by hand. They will be threshed, bulked, and planted as F3 generation next season. We have planted 11 F3 and 38 F4 families in 3.7 ft wide x 15 ft long plots. Selection among families were conducted twice during the season for disease pressure and final selection for plant population and head size was conducted during the harvest. 20 heads from each selected F3 family were picked by hand. The heads will be threshed, bulked, and planted as F4 generation next season. From F4 generation, we extracted lines by selecting 20-50 heads, which will be threshed individually and will form F5 generation head row nursery of 2022-23.

Objective 3. Line testing. We have planted 564 stage-1 single-replicated lines for yield and agronomic trait testing in Purdue farm. These were selected from head row nurseries of 2020-21. 156 out of 564 lines were also sent, as sparse testing, to KY, OH, and IL collectively for yield trial. Another set of 68 from 564, as sparse testing, were sent to MI for yield trial. We all are in the middle of sharing data as of July 21, 2022. We planted nearly 140 stage-2 lines in duplicates in Purdue farms in standard yield trial. We planted 28 stage-3 lines in two locations in IN (ACRE and VIN) each in triplicates. This set was also tested by collaborators in MI, OH, IL, and KY in only single replicate. Similarly, we

planted 28 Elite (stage-4) lines in two locations in IN (ACRE and VIN) each in triplicates. This set was also tested by collaborators in MI, OH, IL, and KY in two replicates.

Objective 4. Scab testing of advanced lines. Two reps of FHB evaluation rows for each of the stage-3 and Elite lines were tested in scab nursery. We inoculated them with scabby corn kernels, and created a desirable environment for disease establishment by using misted irrigation post-inoculation. Incidence and severity were taken in a scale of 1-9. Rows were harvested by hand. They will be threshed, FDK will be measured, and grain samples will be sent to University of Minnesota for DON testing.

b) What were the significant results?

Breeding trials were successfully harvested. Variations in grain yield and FHB traits were observed during the season and harvest time. At this point (July 21) we are preparing data by incorporating plot length and plant height to use ourselves and share with other breeding programs.

c) List key outcomes or other achievements.

The key outcome after we finalize data and share them with collaborators will be selection of higher and more stable yielding lines across multi-location. The ultimate outcome will be selection of candidates for variety release.

3. What opportunities for training and professional development has the project provided?

Two graduate students not funded by this grant were educated essentials of field-based plant breeding. In particular, they learned management of segregating generations and how to handle them. One postdoctoral laboratory scientist not funded by this project, significantly invested time in harvest and learned some aspects of field-based plant breeding.

4. How have the results been disseminated to communities of interest?

Dr. Mohammadi will be presenting a poster from the breeding activities supported by this grant in the National Association of Plant Breeders Conference in Iowa in August 2022 (See Publications, Conference Papers, and Presentations Section). Dr. Mohammadi also aims to present a breeding poster in USWBSI Forum 2022.

Project 2:

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1. What are the major goals and objectives of the research project?

The goal of this project is to explore how advanced lines produced from each breeding program shows FHB resistance phenotypes in diverse locations. Strong FHB resistance must be combined with high-yield to impact the Eastern US wheat industry. Resistance to FHB has a moderate heritability. Therefore, multi-location testing is needed to determine the FHB resistance and yield stability. In our region, breeders from five states use a series of coordinated nurseries to test germplasm for yield and FHB resistance in multiple location so to select and advance germplasm for variety release. Information from multiple locations helps to perform informed selection. Specific objectives of Purdue wheat program were:

1. Participating in preliminary and advanced nurseries, and the coordinated P+NUWWSN FHB experiment.
2. Participating in 5-state preliminary and advanced nurseries
3. Participating in uniform eastern regional winter wheat nurseries (UERWWN)

2. What was accomplished under these goals or objectives? *(For each major goal/objective, address these three items below.)*

a) What were the major activities?

Objective 1. Coordinated trials. We have grown 5-state preliminary and advanced trials (coordinated by Dr. Clay Sneller) in three replicates. We have grown Uniform Eastern Soft Red Winter Wheat trial (coordinated by USDA in North Carolina) in four replicates.

Objective 2. Scab nursery. We have grown the preliminary northern uniform winter wheat nursery and the northern uniform winter wheat nursery. We initially planed for three row replicates per entry. However mechanical failure occurred, and the trays split open. As a consequence, we only had one replicate of NUWWSN and two replicates of PNUWWSN. We inoculated them with scabby corn kernels, and created a desirable environment for disease establishment by using misted irrigation post-inoculation. Incidence and severity were taken in a scale of 1-9. Rows were harvested by hand. They will be threshed, FDK will be measured, and grain samples will be sent to University of Minnesota for DON testing.

b) What were the significant results?

Breeding trials were successfully harvested. At this point (July 21) we are preparing data by incorporating plot length and plant height to use ourselves and share with other breeding programs. In addition, incidence and severity traits were measured from the scab nursery, which will be complemented with FDK and DON and then reported to the coordinator.

c) List key outcomes or other achievements.

The key outcome after we finalize data and share them with collaborators will be selection of higher and more stable yielding and lines across multi-location. The results will also identify lines that are resistant or moderately resistant to FHB across wider environments.

3. What opportunities for training and professional development has the project provided?

Two graduate students not funded by this grant were involved in harvest and one of them was more closely work on the scab nursery.

4. How have the results been disseminated to communities of interest?

The results will be shared soon with breeders and coordinators.

Project 3:

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1. **What are the major goals and objectives of the research project?**

   This project was formed in order to introduce useful genetic diversity to soft red winter wheat from the European germplasm. Among several ways to control FHB disease, the use of resistant varieties is environmentally friendly and the most economical way to manage the disease. However, breeding resistant varieties to any diseases requires the availability of resistance and effective genes in the breeding nurseries. To date, the sources of resistance can be attributed to only few plant introductions e.g., Sumai 3 and native germplasm e.g., Truman, Ernie and Freedom. These handful of sources of variations are being used by the soft red winter wheat breeding programs to develop varieties. Continuous use of same varieties will lead to the loss of genetic diversity, which then results in diminishing genetic gains.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

   a) **What were the major activities?**

   In 2020-21, we planted 2,850 lines in row nurseries and based on winter survival, crop stand, spike appearance selected ~190 accessions, to grow in scab nursery of 2021-22. ~80 of these were also planted in 2021-22 in yield trial.

   b) **What were the significant results?**

   We learned that the ~190 accessions that were planted in scab nursery were generally late flowering compared to adapted germplasm. Despite our effort in inoculating the field and misted irrigation, not of them showed symptom of disease and all scaped. From the ~80 lines tested in yield trial, only 11 lines with reasonable plant canopy, plot appearance, were selected and harvested.

   c) **List key outcomes or other achievements.**

   To this end, we were not able to identify FHB resistant germplasm from this set. The 11 lines that were selected may be used in crossing block to diversify genetic background.

3. **What opportunities for training and professional development has the project provided?**

   One graduate student not funded by this grant were educated with essentials of FHB rating in misted nursery.

4. **How have the results been disseminated to communities of interest?**

   Despite my hope for this germplasm and two years of work, this project did not generate significant data which is worth disseminating in this project.

Publications, Conference Papers, and Presentations

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_____ **award period**

Did you publish/submit or present anything during this award period?

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Journal publications as a result of FY21 grant award

List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Include any peer-reviewed publication in the periodically published proceedings of a scientific society, a conference, or the like.

Books or other non-periodical, one-time publications as a result of FY21 grant award

Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like.

Other publications, conference papers and presentations as a result of FY21 grant award

Mohammadi M. 2022. NorGrains Genomic Selection Pipeline at Purdue. National Association of Plant Breeders NAPB. Ames, Iowa. August 8-11, 2022